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IS 5051-1 (1982): Relays for Electronics and Telecommunication Equipment, Part I: General Requirements and Tests [LITD 3: Electromechanical Components and Mechanical Structures for Electronic Equipment]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

SPECIFICATION FOR
RELAYS FOR ELECTRONICS AND
TELECOMMUNICATION EQUIPMENT

PART I GENERAL REQUIREMENTS AND TESTS

(First Revision)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard

SPECIFICATION FOR RELAYS FOR ELECTRONICS AND TELECOMMUNICATION EQUIPMENT

PART I GENERAL REQUIREMENTS AND TESTS

(First Revision)

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Indian Standard

SPECIFICATION FOR RELAYS FOR ELECTRONICS AND TELECOMMUNICATION EQUIPMENT

PART I GENERAL REQUIREMENTS AND TESTS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part I) (First Revision) was adopted by the Indian Standards Institution on 23 June 1982, after the draft finalized by the Electromechanical Components for Electronic Equipment Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard (Part I) was originally published in 1969. This revision has been undertaken to take account of the latest technological developments and experience gained through the implementation of the standard since its first publication.

0.3 This standard (Part I) covers general requirements and tests for relays. The detail requirements for different types of relays are covered in the subsequent parts of this standard.

0.4 While preparing this standard, assistance has been derived from JSS 50700-1972 'General requirements for relays (excluding polarised and thermal)', issued by the Directorate of Standardization, Ministry of Defence, India.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard (Part I) covers general requirements and test for judging the electrical, mechanical and climatic properties of relays intended for use in electronic and telecommunication equipment.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 1885 (Part XXVI)-1968* shall apply.

3. TYPE DESIGNATION

3.1 Type designation for the relays shall be denoted by the following code:

R XXX

where

The first letter 'R' represents the type of component-relay;

The second letter represents type of relay operation, principle-wise, such as 'R' for reed type, 'A' for armature type;

The third letter 'S', if any, for sealed relays, if relay is of sealed type; and

The number such as 1, 2, etc immediately following the letters represents relay type.

4. CLIMATIC CATEGORIES

4.1 Climatic categories shall be as specified in Table 1.

TABLE 1 CLIMATIC CATEGORIES

CLIMATIC TEST	SEVERITY			
	Category 1		Category 2	Category 3
	A	B		
(1)	(2)	(3)	(4)	(5)
Dry heat	+ 125°C	+ 85°C	+ 85°C	+ 70°C
Cold	- 65°C	- 55°C	- 40°C	- 10°C
Damp heat (steady state)	56 days	56 days	56 days	21 days
Damp heat (cyclic)	6 cycles	6 cycles	6 cycles	2 cycles
Rapid change of temperature	+ 125°C to - 65°C	+ 85°C to - 55°C	+ 85°C to - 40°C	+ 70°C to - 10°C
Low air pressure	4.4 kPa	4.4 kPa	30 kPa	60 kPa

NOTE — In case of special requirements, other combinations of severities may be chosen from IS : 9000*.

*Basic environmental testing procedures for electronic and electrical items.

*Electrotechnical vocabulary : Part XXVI Telecommunication relays.

5. WORKMANSHIP

5.1 Relays shall be manufactured and processed in a careful and workman-like manner in accordance with good design and sound engineering practice.

5.2 Because of the liability of metal crystalline growths between the canister and the relay, and between the relay parts, the use of electroplating on all surfaces inside sealed relays is not permitted.

6. MARKING

6.1 Each relay shall be clearly and indelibly marked with details given in (a) and (b) below and with as many remaining details in the order given below as is practicable:

- a) Type designation code;
- b) The schematic diagram of the coil and spring set terminal connections, with the resistance of the coil and, where appropriate, the nominal voltage and current;

NOTE — Relays shall have the spring set terminal connections indicated by the use of basic contact forms shown in Fig. 1.

- c) Manufacturer's name or trade-mark; and
- d) Any other markings specified in the detail specification.

6.1.1 The relay may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. TESTS

7.0 General

7.0.1 Atmospheric Conditions for Testing — Unless otherwise specified, all tests shall be performed under standard atmospheric conditions as specified in IS: 9000 (Part I)-1977*.

7.0.2 Preconditioning — Wherever necessary, a preconditioning procedure shall be followed before performing the actual tests.

7.0.3 Accuracy of Test Equipment — The accuracy of test equipment shall be as specified in the relevant test clause.

*Basic environmental testing procedures for electronic and electrical items: Part I General.

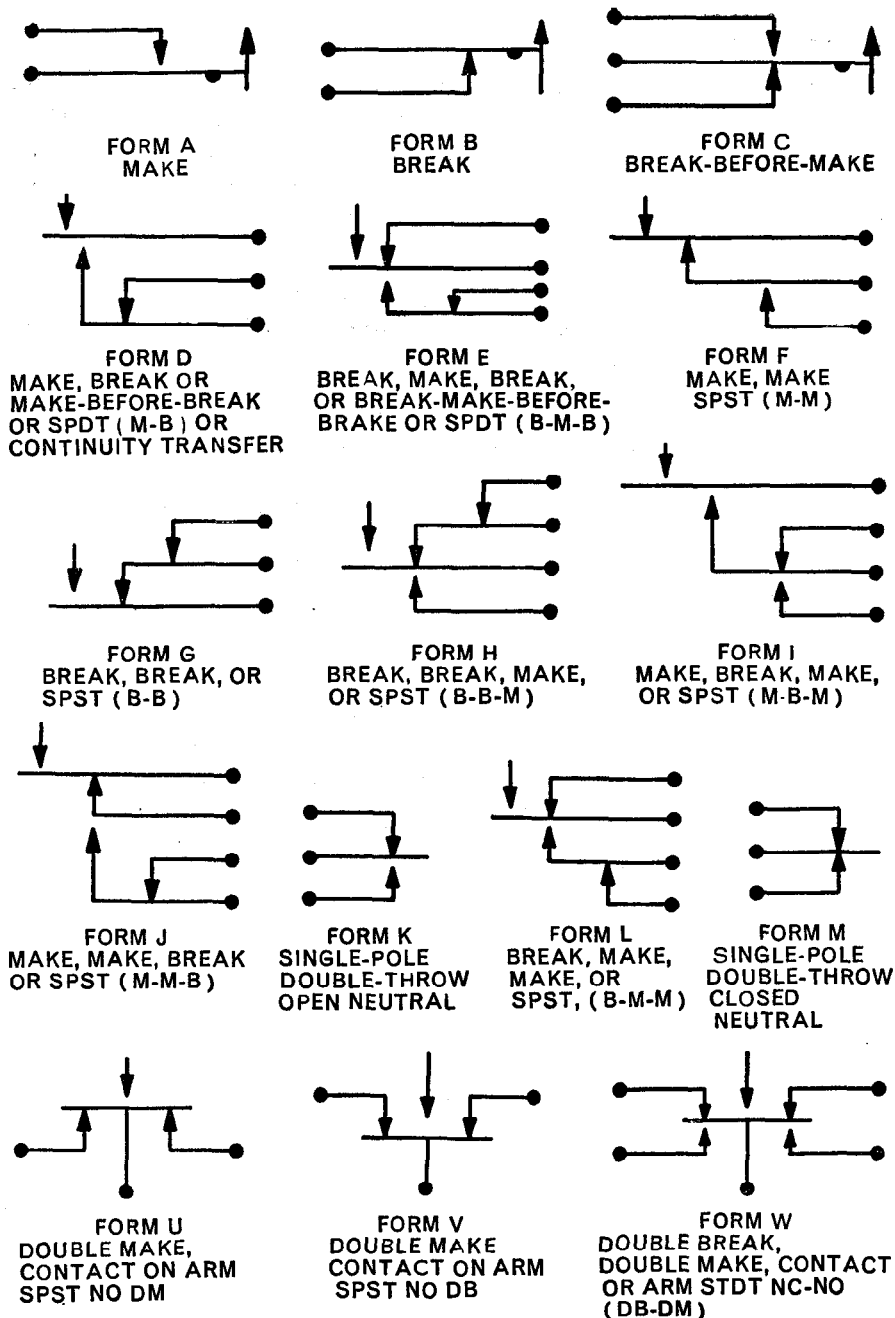


FIG. 1 BASIC CONTACT FORMS

7.0.4 Test Voltage, Current or Frequency — Where tests are specified to be made at rated working voltage or current or frequency, the actual values shall be within ± 5 percent of the nominal values, unless otherwise specified.

7.1 Type Tests — The schedule of type tests is given in Table 2.

TABLE 2 SCHEDULE OF TYPE TESTS

GROUP	NO. OF SAMPLES	TEST	CLAUSE REF
(1)	(2)	(3)	(4)
0	20	General examination	7.4
		Dimensions (outline)	7.4.2
		Coil resistance	7.5
		Static contact resistance	7.6
		Pickup and dropout voltage	7.7
		Contact bounce	7.8
		Voltage proof	7.9
		Insulation resistance	7.10
		Operate and release time	7.11
		Contact noise	7.38
		Cross talk	7.37
		Capacitance	7.12
		Power factor	7.13
		Conditioning (run-in)	7.14
		Contact alignment	7.15
		Sealing	7.16
1	4	Weight	7.4.3
		Solderability	7.17
		Robustness of terminations	7.18
		Impact (bump)	7.19
		Vibration	7.20
	4	Impact (shock)	7.21
		Acceleration (steady state)	7.22
		Air pressure	7.23
		Change of temperature	7.24
		Climatic sequence	7.25
2	2	Damp heat (steady state)	7.27
3	2	Mould growth	7.28
4	4	Overload	7.29
		Life (electrical and mechanical)	7.30
5	4	Resistance to solvents	7.31
		Resistance to soldering heat	7.32
6	2	Magnetic interference	7.33
		Dust	7.26
		Contact sticking	7.39
		Coil life	7.34
7	2	Salt mist	7.35
7	2	Minimum current (intermediate current)	7.36

7.1.1 Type Approval Procedure — Procedure for type approval shall be in accordance with IS : 2612-1965*.

7.1.2 Number of Samples — Unless otherwise specified, the number of samples for type tests shall be 20 for a given style of relays.

7.2 Acceptance Tests — Acceptance tests shall be carried out on samples which have passed the routine tests. Two groups of samples, Group A and Group B, shall be selected and the relays in each group shall be subjected to the tests given in Table 3.

TABLE 3 SCHEDULE OF ACCEPTANCE TESTS

TEST	CLAUSe REF	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL*	D/ND†
(1)	(2)	(3)	(4)	(5)
<i>Group A Tests:</i>				
Dimensions (outline)	7.4.2			
Coil resistance	7.5		II	ND
Contact bounce	7.8			
Operate and release time	7.11			
Sealing (fine leak) (for hermetically sealed reed relays only)	7.16			
<i>Group B Tests:</i>				
<i>Sub-Group I</i>				
Weight	7.4.3	4	S 3	ND
<i>Sub-Group II</i>				
Minimum current‡	7.36	4	S 3	ND
<i>Sub-Group III</i>				
Solderability	7.17			
Robustness of terminations	7.18	4	S 3	D
Impact (bump)	7.19			

*See Indian Standard sampling plans and procedures for inspection by attributes for electronic items (under preparation).

†Destructive/non-destructive.

‡When minimum current is not applicable, low level testing shall be performed only in the case of relays, armature, other than hermetically sealed, otherwise resistive load testing procedure shall be followed for 100 000 operation.

*Recommendation for type approval and sampling procedure for electronic components.

7.3 Routine Test — The schedule of routine tests is given in Table 4.**TABLE 4 SCHEDULE OF ROUTINE TEST**

SL No.	TEST	CLAUSe REF
(1)	(2)	(3)
i)	Visual examination	7.4.1
ii)	Static contact resistance	7.6
iii)	Pickup and drop out voltage	7.7
iv)	Voltage proof (2 s)	7.9
v)	Insulation resistance	7.10
vi)	Sealing (gross leak) (for sealed patterns only)	7.16

7.4 General Examination

7.4.1 Visual Examination — The specimen shall be visually examined.

The condition, workmanship and finish shall be satisfactory. The markings shall be legible.

7.4.2 Dimensions (Outline) — The dimensions shall be checked for compliance with the outline drawings specified in the relevant specifications.

7.4.3 Weight — A minimum of 6 specimens shall be weighed. The weight of each specimen shall not exceed the maximum weight specified in the relevant specification.

7.5 Coil Resistance — The resistance of the coil winding shall be measured with a resistance bridge or other suitable method. The limits of the error in the bridge or test equipment shall not exceed one-tenth of the specified tolerance on the measured resistance (for example, the limits of the error in the bridge or other test equipment shall not exceed ± 0.5 percent if the specified tolerance on the measured resistance is ± 5 percent). If the tolerance is not specified, the limits of the error shall not exceed ± 2 percent.

The value, corrected if necessary, for ambient temperature shall be within the limits as specified in the relevant specification.

7.6 Static Contact Resistance — The static contact resistance shall be measured and the following details shall apply:

Points of Measurements:

- Between all normally closed contacts;
- Between all normally open contacts, with coil energized with rated voltage (or current). The relay shall be operated with no load applied to contacts.

Actuations and Measurements:

- c) Number of test actuations — Three.
- d) Number of measurements per actuation — One in each closed contact position.

The voltmeter-ammeter method, Kelvin bridge or any suitable test circuit for measurement may be utilised. The contact resistance shall normally be calculated from the potential difference measured between the points at which the external leads are normally connected to the terminals. A test current as specified in the relevant detail specification shall be passed through the contacts during the measurement and the voltage drop across them measured. The maximum open-circuit test voltage shall be as specified, with a maximum allowable error 5 percent.

The voltage drop across any pair of contacts or the contact resistance shall be as specified in the relevant specification.

7.7 Pickup and Dropout Voltage — Pickup and dropout voltage (or current) shall be measured as specified below:

For type tests, the relay shall be mounted in each or three mutually perpendicular planes, unless otherwise specified. For acceptance tests, the relay mounting position is optional. A suitable indicating device shall be used to monitor contact operation.

- a) *Pickup Voltage (or Current)* — Rated coil voltage (or current) shall be applied to the coil for a period of one to three seconds. The voltage shall be gradually reduced to zero (the contacts of the latching relays shall be caused to transfer). The voltage shall then be gradually increased until the relay operates, and the pickup voltage (or current) shall be measured; and
- b) *Dropout Voltage (or Current)* — Rated coil voltage (or current) shall be applied to the coil. The voltage shall be gradually reduced until the contacts return to the de-energised position and the dropout voltage (or current) shall be measured.

The pickup and dropout voltage (or current) shall be as specified.

7.8 Contact Bounce — Contact bounce shall be measured on each contact set using an oscilloscope. The trace shall show contact switching at operate and release and appropriate timing markers. Rated coil voltage shall be applied to the coil. Unless otherwise specified, contact shall be loaded up to the rated current and voltage. The circuit shown in Fig. 2 or equivalent shall be used.

The duration of contact bounce shall not exceed 2 ms, unless otherwise specified in the relevant specification.

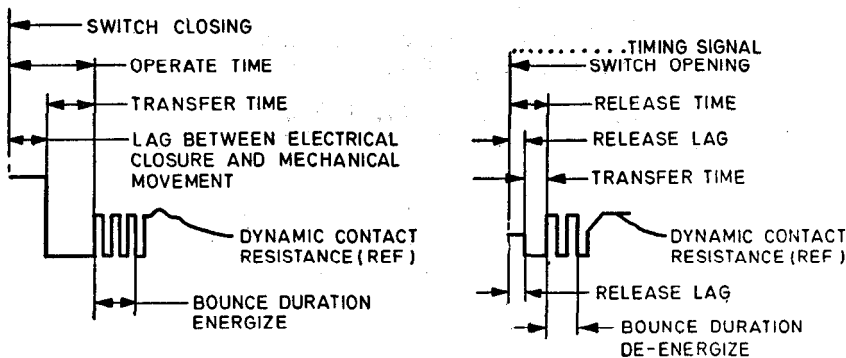
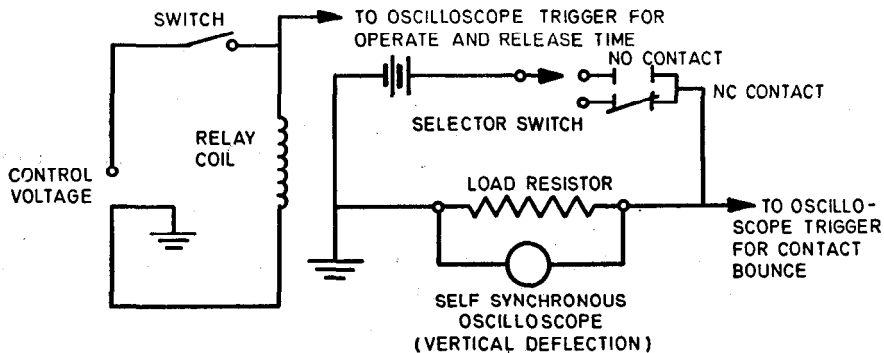


FIG. 2 OPERATE AND RELEASE TIME MEASUREMENT

7.9 Voltage Proof — Unless otherwise specified, the procedure mentioned below shall be applied between the mutually insulated parts. When special preparation or conditions are required, they shall be specified in relevant specification along with the following:

- Magnitude and nature of test voltage;
- Points of application;
- Methods of connection of the test voltage to the specimen should be specified (only when necessary);
- The test voltage shall be raised gradually from zero to the specified value at a rate of 500 volts (rms or dc) per second, unless otherwise specified;
- Unless otherwise specified the test voltage shall be maintained at a specified value, for a period of one minute during type approval testing. For acceptance tests, when specified, reduced time with a possible correlated higher voltage may be used. On completion of the test, voltage shall be gradually reduced;

- f) During the test the fault indicator shall be monitored for disruptive discharge and leakage current;
- g) A voltmeter shall be used to measure the applied voltage to an accuracy of at least 5 percent, unless otherwise specified;
- h) When required a suitable current limiting device shall be used to limit current surges to the value specified; and
- k) Any special requirements as specified.

There shall be no breakdown or flashover, and current leakage shall not exceed 1 mA, unless otherwise specified in the relevant specification.

7.10 Insulation Resistance — Unless otherwise specified, insulation resistance measurements shall be carried out with an apparatus suitable for the characteristics of the component to be measured, such as a megohm bridge, megohm meter, or any other suitable apparatus. The direct current potential applied to the specimen shall be that indicated by one of the following test condition letters, as specified.

<i>Test Condition Letter</i>	<i>Test Voltage V (dc)</i>
A	100 \pm 10 percent
B	500 \pm 10 percent
C	1 000 \pm 10 percent

Unless otherwise specified, the measurement error at the insulation resistance value required shall not exceed 10 percent. Proper guarding techniques shall be necessary to prevent erroneous readings due to leakage along undesired paths.

The insulation resistance value shall be as specified in the relevant specification.

7.11 Operate and Release Time — The operate and release time shall be measured using an oscilloscope. Rated coil voltage shall be applied to the coil. The circuit shown in Fig 2 or equivalent shall be used. The operate and release time shall be exclusive of contact bounce. For type testing, timing measurements shall be made on all contact sets. For acceptance testing all open contacts may be wired in series and all closed contacts in parallel.

In multipole relays, all poles of each relay shall function simultaneously within one millisecond. Double throw contacts shall show no evidence of an open contact being closed concurrently with a closed contact, unless makebefore-break action is specified.

Operate and release time shall be as specified in the relevant specification.

7.12 Capacitance — The capacitance shall be measured at 1 MHz using a bridge, or any other suitable instrument between the following points (unless otherwise specified):

- a) Between contacts which are electrically insulated, and
- b) Individual contacts and frame.

Accuracy of measurements shall be ± 0.5 percent $+ 0.2 \mu\text{F}$. The capacitance value shall be as specified in the relevant specification.

7.13 Power Factor — The power factor shall be measured at 1 MHz.

The power factor shall be as specified in the relevant specification.

7.14 Conditioning (Run-in) — Relay shall be subjected to 5 000 operations at 1 to 5 operations per second under the following conditions:

- a) Unless otherwise specified the coil shall be energised at rated voltage or as specified,
- b) Each pair of contacts shall be monitored for dynamic contact resistance, and
- c) The contact shall be loaded at low level, unless otherwise specified.

Unless otherwise specified, maximum dynamic contact resistance shall be as follows:

<i>Contacts or Level of Operation</i>	<i>Load Conditions</i>	<i>Dynamic Contact Resistance (or Voltage Drop)</i>
High level	Rated current at rated voltage	10 percent of open circuit voltage
Minimum current (see 7.36)	Level 1	1 ohm
	Level 2	3 ohms
Low level	10 mA at 30 mV dc or ac peak (open circuit voltage)	50 ohms

7.15 Contact Alignment — The alignment of pairs of contacts which make or break, shall be judged visually.

The contacts shall not be out of alignment by more than one-fifth of the contact diameter for high level contacts, and one-third of the contact diameter for other types.

7.16 Sealing — The test shall be carried out in accordance with IS: 9000 (Part XV)-1982*. The leakage rate of gas shall be as specified in the relevant specification.

7.17 Solderability — The test shall be carried out in accordance with Sec 1 of IS: 9000 (XVIII)-1981*. Each termination shall be tested.

7.18 Robustness of Terminations — The test shall be carried out in accordance with IS: 9000 (Part XIX)-1978*. Two terminals of each discrete design shall be tested.

No fracture, or loosening of parts or other mechanical deterioration shall occur. Any other requirements shall be as specified in the relevant specification.

7.19 Impact (Bump) — The test shall be carried out in accordance with Sec 2 IS: 9000 (Part VII)-1979*.

7.19.1 Preliminary — Unless otherwise specified, the specimens shall be mounted in their normal manner. The relays which cannot be mounted by normal means (without provision for mounting) shall be mounted rigidly on a non-magnetic mounting plate by means of potting or adhesive suitably applied between the top of the relay and the mounting plate.

7.19.2 Electrical Loading — For the first 2 000 bumps the relays coil shall be kept energised at the rated coil voltage (or current). For the second 2 000 bumps the relay shall not be energised.

7.19.3 Intermediate Measurement — Suitable monitoring device shall be used. Observation shall be made for false opening or closing of relay contacts. The time of false operation shall be as specified in the relevant specification.

7.19.4 Final Measurement — The relay shall be visually examined. No mechanical damage or deterioration shall occur.

7.20 Vibration — The test shall be carried out by endurance by sweeping method of IS: 9000 (Part VIII)-1981* at the severity specified. Prior to the test, one relay shall be mounted on the test table and pickup and drop out voltage shall be measured with the table coil de-energised; the measurement shall be repeated with the table coil energised. If there is difference in values of pick-up and drop out voltage of more than 5 percent, magnetic

*Basic environmental testing procedures for electronic and electrical items:

Part XV Sealing test.

Part XVIII Solderability test.

Part XIX Test for robustness of terminations and integral mounting device.

Part VII Impact test.

Part VIII Vibration test.

shielding shall be used so that the values measured with the table coil energised does not vary more than 5 percent from the value measured with the table coil de-energised.

7.20.1 Preliminary — The specimens shall be mounted by their normal means (the relays designed without mounting provisions shall be rigidly secured to a suitable non-magnetic mounting plate by means of potting or adhesive suitably applied between the top of the reply and the mounting plate).

7.20.2 Electrical Loading — Relays shall be tested with the coil energised with the rated coil voltage (or current), in each of the three mutually perpendicular directions (relays with intermittent duty coils shall not be energised above their duty cycle), unless otherwise specified. Contacts shall not be loaded. Time for energising and de-energising the relay shall be as specified.

7.20.3 Intermediate Measurements — Observation shall be made for false opening or closing of relay contacts. The time of false operation shall be as specified in the relevant specification.

7.20.4 Final Measurements

- a) *Visual examination* — The specimen shall be visually examined. No mechanical damage or deterioration shall occur.
- b) *Voltage proof* — See 7.9.
- c) *Static contact resistance* — See 7.6. The value shall be as specified in the relevant specification.
- d) *Pickup and dropout voltage* — See 7.7. The value shall be as specified in the relevant specification.

7.21 Impact (Shock) — The test shall be carried out in accordance with Sec 1 of IS : 9000 (Part VII)-1979*, at the severity specified.

7.21.1 Preliminary — The specimens shall be mounted as in 7.20.1 in each of the three mutually perpendicular positions.

7.21.2 Electrical Loading — In each direction of shock, the relays shall be de-energised during two shocks and energised with the rated coil voltage (or current) during one shock.

7.21.3 Intermediate Measurements — Observation shall be made for false opening or closing of the relay contacts. The time of false operation shall be as specified in the relevant specification.

*Basic environmental testing procedures for electronic and electrical items: Part VII Impact test.

7.21.4 Final Measurements

- a) *Visual examination* — The specimen shall be visually examined. No mechanical damage or deterioration shall occur.
- b) *Voltage proof* — See 7.9.
- c) *Static contact resistance* — See 7.6. The value shall be as specified in the relevant specification.
- d) *Pickup and dropout voltage* — See 7.7. The value shall be as specified in the relevant specification.

7.22 Acceleration (Steady State) — The test shall be carried out in accordance with 7.7 of IS: 589-1961* at the severity specified.

7.22.1 Preliminary — The specimens shall be mounted as in 7.19.1.

7.22.2 Electrical Loading — In each of the three mutually perpendicular directions the relays shall be de-energised for 5 minutes; rated coil voltage (or current) shall be applied momentarily, and the voltage (or current) shall be reduced to one-half rated for an additional 5 minutes contacts shall be monitored for proper position.

7.22.3 Requirement — The contacts shall remain in the de-energised condition with no voltage across the coil, and in the energised position when the coil voltage is reduced from the specified rated voltage to one-half of the specified rated voltage. Latching type relays shall remain in each latched position with no voltage on the coil.

7.22.4 Intermediate Measurement — Observation shall be made for false opening or false closing of the relay contacts. The time of false operation shall be as specified in the relevant specification.

7.22.5 Final Measurements

- a) *Visual examination* — The specimen shall be visually examined. No mechanical damage or deterioration which might impair the operation of the relay shall occur.
- b) *Sealing* — As in 7.16.

7.23 Air Pressure — The specimens shall be subjected to an air pressure of 200 kPa in the following manner.

The air pressure shall be increased to the equivalent of 200 kPa. The time taken to reach this pressure shall be approximately one fourth of an hour, and the pressure shall be maintained for one hour after which it shall be slowly reduced to the normal value. The relay shall then be removed from the chamber and visually examined.

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (revised).

No damage, deformation of the cover or breaking of the seal shall occur. Invisible cracks are to be checked later as in 7.16.

7.24 Change of Temperature — This test shall be carried out according to Sec 1 of IS : 9000 (Part XIV)-1978* (except that exposure timings shall be 30 min in each chamber) at the maximum and minimum temperature of the temperature severity specified in the relevant specification.

7.24.1 The specimens shall be suspended in the test chamber by twine, or other non-heat conducting material, in plane parallel to the normal air flow. Test leads may be used for mounting; however, they shall not provide a heat sink.

7.24.2 Intermediate Measurement — As specified in the relevant specification.

7.24.3 Final Measurement

a) *Visual examination* — The specimens shall be visually examined. No cracking, peeling or flaking of the finish shall occur.

b) *Voltage proof* — See 7.9.

7.25 Climatic Sequence — The sequence of tests shall be carried out in accordance with IS : 9000 (Part I)-1977* at the severities specified in the relevant specification.

7.25.1 Preliminary — The specimens shall be mounted by their normal means.

7.25.2 Intermediate Measurement — The following measurement shall be made subsequent to removal from the conditioning chamber for dry heat, dry cold, damp heat (cyclic) and air pressure (low) tests after following the appropriate recovery period specified in IS : 9000.

The specimen shall be visually examined. There shall be no corrosion, fracture, loosening of parts or other mechanical deterioration such as would impair the operation, the marking shall be legible and indelible.

7.25.3 Dry Heat — The test shall be carried out in accordance with Sec 5 of IS : 9000 (Part III)-1977* at the maximum temperature of the temperature severity. For the last hour of the cycle the specimens shall be held operated with the rated coil voltage or (current) specified in the relevant specification.

*Basic environmental testing procedures for electronic and electrical items:
 Part XIV Change of temperature.
 Part I General.
 Part III Dry heat test.

7.25.4 Damp Heat (Cyclic) First Cycle — The test shall be carried out according to Sec 2 of IS : 9000 (Part V)-1981*.

7.25.5 Cold — This test shall be carried out according to Sec 4 of IS : 9000 (Part II)-1977* at the minimum temperature of the temperature severity.

7.25.6 Low Air Pressure — This test shall be carried out according to IS : 9000 (Part XIII)-1981* at the severity specified in the relevant specification for 5 minutes. Whilst the specimens are still at low air pressure, they shall be subjected to the following test:

Voltage Proof — As in 7.9, except that the applied voltage shall be as specified in the relevant specification.

7.25.7 Damp Heat (Cyclic), Remaining Cycles — This test shall be carried out in accordance with Sec 2 of IS : 9000 (Part V)-1981*.

7.25.7.1 Damp heat (cyclic) — Two cycles.

7.25.7.2 Damp heat (cyclic) — 6 cycles within 15 minutes after removal from the chamber, the following measurements shall be carried out.

- a) *Coil resistance* — As in 7.5.
- b) *Pickup and dropout voltage* — As in 7.7.
- c) *Insulation resistance* — As in 7.10 (within one and a half to two hours recovery). The value shall be as specified in the relevant specification.

7.25.8 Final Measurements — The following measurements shall be made after completion of 24 hours recovery.

- a) *Visual examination* — The specimens shall be visually examined. For requirements, see 7.25.2.
- b) *Voltage proof* — See 7.9.
- c) *Insulation resistance* — See 7.10. The value shall be as specified in the relevant specification.
- d) *Sealing* — See 7.16.

7.26 Dust — The test shall be carried out according to IS : 9000 (Part XII)-1981*.

*Basic environmental testing procedures for electronic and electrical items:

Part V Damp heat (cyclic) test.
Part II Cold test.
Part XIII Low air pressure test.
Part XII Dust test.

7.26.1 Final Measurements:

- a) *Static contact resistance* — See 7.6.
- b) *Pickup and dropout voltage* — See 7.7.

7.27 Damp Heat (Steady State) — The tests shall be carried out according to IS : 9000 (Part IV)-1979* at the severity specified in the relevant specification.

7.27.1 Preliminary — The specimens shall be mounted by their normal means.

7.27.2 Intermediate Measurements — The specimens shall be removed from the chamber, shaken so as to remove the droplets of the water, and subjected to the following tests after allowing a recovery for 15 minutes.

- a) *Visual examination* — The specimens shall be visually examined. No corrosion or other mechanical deterioration which would impair the operation shall occur.
- b) *Coil resistance* — See 7.5.
- c) *Pickup and dropout voltage* — See 7.7.
- d) *Insulation resistance* — As in 7.10, whilst under atmospheric conditions for recovery, between one and a half to two hours after removal from the chamber. The value shall be as specified in the relevant specification.

7.27.3 Final Measurements — The following measurements shall be made after the completion of 24 hours.

- a) *Voltage proof* — See 7.9.
- b) *Insulation resistance* — See 7.10. The value shall be as specified in the relevant specification.
- c) *Sealing* — See 7.16.
- d) *Solderability* — See 7.17.

7.28 Mould Growth — The test procedure and requirements shall be according to IS : 9000 (Part X)-1979*.

7.29 Overload — This test shall not be applied for low level relays. Relay contacts (both normally open and normally closed) shall be subjected to the loads specified below as applicable. All normally open contacts shall be tested together, then all normally closed contacts tested together. The number of operations shall be 100 for dc contact loads, and 200 for ac contact loads (' on ' and ' off times shall be approximately equal). The

*Basic environmental testing procedures for electronic and electrical items:
 Part IV Damp heat (steady state).
 Part X Mould growth test.

coil shall be energised at rated coil voltage. Overload current shall be twice the rated load current. The opening and closing of all contacts shall be continuously monitored to detect the actual mechanical and electrical switching of the contacts. The equipment shall be capable of monitoring 50 percent of the actual opened and closed time of each contact. The equipment shall automatically cut off when a failure occurs, or shall record any failures. The relay frame, case, or enclosure shall be connected to system-ground through a normal blow fuse rated at 5 percent of the test load or 100 mA, whichever is greater. After the test, the fuse shall be tested for electrical continuity.

- a) *Resistive* — Suitable resistors shall be used, cycling rate shall be 20 ± 2 cycles per minute.
- b) *Inductive* — Cycling rate shall be 10 ± 1 cycles per minute.
 - 1) *Inductive dc* — Unless otherwise specified, inductive dc loads shall be computed in accordance with the formula $CE^2 = (0.28) I^{1.181}$. A shunting capacitor shall be placed across the test contacts to absorb the arc energy. The voltage across the capacitors shall be measured upon circuit interruption by means of an oscilloscope and shall be taken as the peak value of the first oscillation.

where

W = Energy (in joules);

C = Capacitance of shunt capacitor (in farads);

E = Voltage across capacitor (in volts); and

I = Maximum dc inductive current rating of contacts.

The energy thus calculated is the energy which could be dissipated by the contacts if the capacitors were removed. This energy shall be within 10 percent of the energy calculated by the formula $W = (0.14) I^{1.181}$. This method of energy measurement requires the use of a pulse-type non-inductive capacitor having a working voltage of 1 000 volts. The size of the capacitor shall be such that the peak voltage measured shall be neither less than 200 nor greater than 900 volts. During the overload test, the capacitor shall be disconnected. When specified, the inductive load shall have an L/R ratio of 0.008.

- 2) *Inductive ac* — The load shall consist of inductive and resistance elements with 0.7 ± 0.05 lagging power factor at the voltage and frequency specified.

- c) *Lamp* — The load shall consist of tungsten lamps which shall be operated at approximately their rated voltage. The cycling rate shall be between 2 and 3 cycles per minute.

The contacts shall successfully make and break the applicable load(s), and the case-to-earth fuse shall remain electrically continuous.

7.30 Life Test (Electrical and Mechanical) — The test shall be done according to Appendix A at the maximum temperature of the dry heat test severity. The specimens shall be subjected to the number of operations as specified for each load.

Unless otherwise specified, relays shall be cycled for 100 000 operations. The relay coil shall be energised non-synchronous with the power supply for ac loads. The relay case shall be connected to the system-ground by a normal blow fuse rated at the 5 percent of the test current or 100 mA, whichever is greater with the exception of motor loads, opening and closing of all the contacts shall be continuously monitored for dynamic contact resistance as in 7.14, the equipment shall be capable of testing 50 percent of the actual closed time of contact. After this test, fuse shall be tested for electrical continuity.

The requirements shall be as specified in the relevant specification.

7.30.1 Preliminary — The specimens shall be mounted in their normal manner. Provision shall be made for automatically stopping the test, in the event of failure of relay contacts.

7.30.2 Electrical Loading — The appropriate contact load and the rated coil voltage (or current) shall be in accordance with the relevant specification.

7.30.3 Final Measurements

- a) *Visual examination* — The specimen shall be visually examined. No electrical or mechanical deterioration likely to impair the operation shall occur.
- b) *Coil resistance* — See 7.5.
- c) *Static contact resistance* — See 7.6. The value shall be as specified in the relevant specification.
- d) *Pickup and dropout voltage* — See 7.7.
- e) *Operate and release time* — See 7.11. The value shall be as specified in the relevant specification.
- f) *Contact bounce* — See 7.8.
- g) *Voltage proof* — See 7.9.
- h) *Insulation resistance*—See 7.10. The value shall be as specified in the relevant specification.

7.31 Resistance to Solvents — Relays shall be tested in accordance with IS : 9000 (Part XX)-1979*. The following details and exceptions shall apply:

- a) *Portion to be brushed* — All markings.
- b) *Examination* — Specimens shall be examined for illegibility of marking. The markings shall remain legible.

7.31.1 Final Measurements

- a) *Static contact resistance* — See 7.6.
- b) *Voltage proof* — See 7.9.
- c) *Insulation resistance* — See 7.10.

7.32 Resistance to Soldering Heat — The test shall be done according to Sec 2 of IS : 9000 (Part XVIII)-1981*. Each termination shall be tested.

7.32.1 Final Measurements

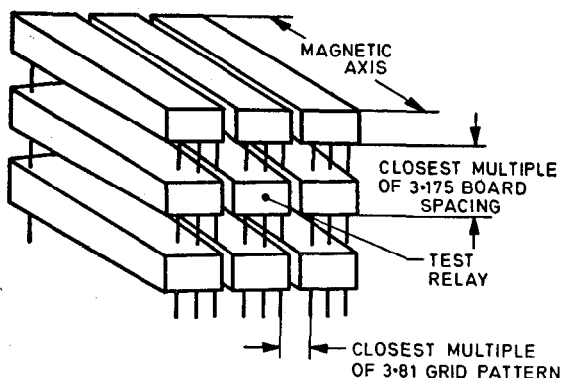
- a) *Visual examination* — The specimens shall be visually examined. No mechanical damage or deterioration shall occur.
- b) *Contact resistance* — See 7.6.
- c) *Insulation resistance* — See 7.10.
- d) *Pickup and dropout voltage* — See 7.7.
- e) *Coil resistance* — See 7.5.

7.33 Magnetic Interference — Relays shall be tested in accordance with the following method or as specified in the relevant specification.

- a) *Uniform-stray field* — The relay shall be mounted by suitable non-magnetic means within the central volume of the test coil (magnetic orientation of the relay may be determined by energising the coil with a known polarity and checking for attraction or repulsion of a permanent magnet to an external surface of the relay). The critical axis of the relay shall be aligned with the longitudinal axis of the test coil. Pickup and dropout voltage (or current) shall be measured as specified in 7.7, in zero magnetic field and in 0.01T magnetic field of both polarities.

*Basic environmental testing procedures for electronic and electrical items:
Part XX Resistance to cleaning solvents and permanence of markings.
Part XVIII Solderability test.

- b) *Adjacent similar relay* — The relay under test and eight similar relays shall be mounted in the same physical orientation by non-magnetic means, as shown in Fig 3. Unless otherwise specified, grid-spaced relays shall be mounted so that all terminals are positioned in the closest possible grid pattern. The spacing between terminals and tops of a adjacent terminals shall be as shown in Fig. 3 unless otherwise specified. Pickup and dropout voltage (or current) shall be measured on the relay under test as specified in 7.7 with the coil of the eight outer relays energised at rated coil voltage (the magnetic polarity of each relay shall be similarly oriented). This measurement shall be repeated with the coils-of the eight outer relays de-energised.



All dimensions in millimetres.

FIG. 3 ARRANGEMENT FOR MAGNETIC INTERFERENCE TEST

7.33.1 Final Measurements — After completion of the test, following measurements shall be carried out.

7.33.1.1 Pickup and dropout voltage — See 7.7.

7.34 Coil Life — Relays shall be tested for 1 000 hours as shown in Fig 4, according to the test method specified below.

7.34.1 Preliminary — Each relay may be attached by its normal means to an approximate 1.59 mm thick (minimum), flat aluminium plate heat sink. The heat sink shall be designed to place every relay in the centre of its own square space whose total surface area (both sides) is eight times the outside surface area of the relay, excluding mounting. Relays without mount shall be held to the heat sink with a metal strap 6.35 mm wide by 0.38 mm (maximum) thickness, the heat sink assembly shall be suspended

by twine or other non-heat-conducting material in a plane parallel to the normal air flow in the oven. The leads shall not constitute a heat sink.

Chamber temperature shall be controlled to maintain the temperature at the specified ambient extremes (see Fig. 4).

Each contact terminal shall be connected as in 7.6.

During the maximum temperature portion of the test, rated coil voltage, as specified in the relevant specification shall be applied continuously and at least half of the normally open contacts shall carry rated current. During room temperature and minimum temperature exposure the coil shall be de-energised and contacts shall not be loaded. Ambient temperatures shall be varied as shown in Fig 4 with heating and cooling rates, not to exceed 1°C per second average. The portion of the cycle run at minimum temperature shall be approximately 10 percent of the test cycle time.

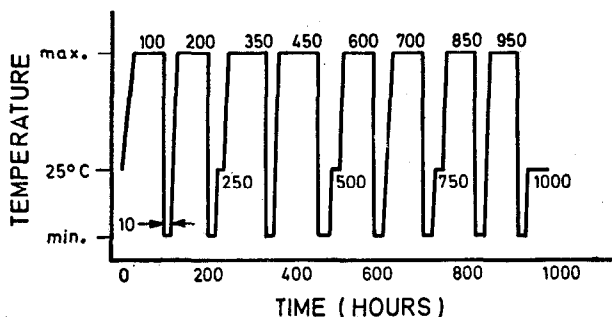


FIG. 4 COIL LIFE TEST - AMBIENT TEMPERATURES

7.34.2 Intermediate Measurements — After the first 100 hours and while still at the low temperature extreme, following measurements shall be carried out:

- a) *Static contact resistance* — See 7.6.
- b) *Operate and release time* — See 7.11. After completion of 250 ± 25 , 500 ± 25 and 750 ± 25 hours, the following measurements shall be carried out at 25°C .
- c) *Coil resistance* — See 7.5.
- d) *Static contact resistance* — See 7.6.

During the last temperature cycle, after allowing the relay to stabilize, de-energise; the pickup and dropout voltage shall be measured at each of the temperature extremes and values shall be recorded.

- e) *Pickup and dropout voltage* — See 7.7.

7.34.3 Final Measurements — After completion of the final cycle, measurements shall then be taken for the following at 25°C.

- a) *Visual examination* — The relay shall be visually examined. There shall no evidence of damage.
- b) *Operate and release time* — See 7.11.
- c) *Contact bounce* — See 7.8.
- d) *Static contact resistance* — See 7.6.
- e) *Coil resistance* — See 7.5.
- f) *Voltage proof* — See 7.9.
- g) *Insulation resistance* — See 7.10. The value shall be as specified in the relevant specification.

7.35 Salt Mist — The test shall be carried out according to 7.10 of IS : 589-1961*.

Salt deposits shall be removed by gentle wash or dip in running water not warmer than 37°C and a light brushing, using a soft hair brush or plastic bristle brush. The following measurements shall be made allowing recovery after cleaning.

7.35.1 Final Measurements — The specimens shall be visually examined. There shall be no evidence of peeling, chipping or finish and exposure of base metal due to corrosion or other mechanical damage, which would impair the application and performance of the relays.

7.36 Minimum Current (Intermediate Current) — For type testing, relay shall be tested as follows:

The ambient temperature of the test chamber shall be at the maximum temperature of the relay category, unless otherwise specified. However, intermittent duty and pulse operated relays shall be operated as specified. The same type load shall be used for each contact of the same pole. Contacts shall be monitored for dynamic contact resistance at each operation; however, unless otherwise specified, contacts carrying rated resistive load need not be monitored. Unless otherwise specified, contacts shall be loaded as follows:

- a) *First pole* — 0.01 A resistive at 28 ± 1 V dc,
- b) *Second pole* — 0.3A inductive (220 mh) at 28 ± 1 V dc,
- c) *Third pole* — 0.5A resistive at 28 ± 1 volts dc, and
- d) *Fourth pole* — Rated resistive at 28 ± 1 V dc.

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (revised).

NOTE — Single pole relays shall not be tested at rated resistive load and the other three loads shall be distributed throughout the test samples in the order shown. Two poles loaded with rated resistive load and the other three loads shall be distributed throughout the test samples in the order shown. Relays having more than four poles shall alternate the 0.1 ampere resistive and rated loads on the remaining poles. For acceptance testing, relays shall be tested as specified herein, except the operations shall be 10 000.

Level 1 — Relays shall be subjected to 100 000 operations (unless otherwise specified) and the rate shall be 20 ± 2 cycles per minute, with ' on ' and ' off ' times approximately equal.

Level 2 — Relays shall be subjected to 50 000 operations (unless otherwise specified) at the rate of 29 ± 3 seconds ' on ' and 1.5 ± 0.5 seconds ' off '.

All contacts shall satisfactorily make and break the current specified and dynamic contact resistance shall be as in 7.14 or as specified in the relevant specification.

7.37 Contact Noise — Contact noise shall be measured using the test circuit shown in Fig. 5. The mercury switch shall be pulsed at a rate not to exceed 5 Hz with ' on ' and ' off ' time approximately equal. The input filter bandwidth of the oscilloscope shall be set at 600 Hz to 100 kHz. An oscilloscope with the time scale adjusted to 2 ms/cm and its gain control adjusted for adequate deflection. The peak to peak voltage shall be determined at 10 ms. The oscilloscope trace shall be recorded using an oscilloscope record camera.

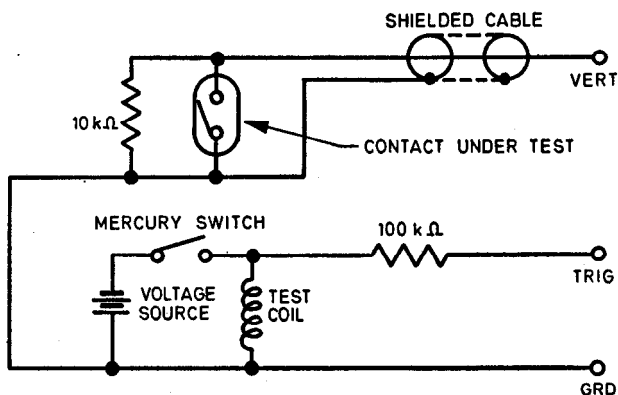


FIG. 5 SET-UP FOR OBSERVING CONTACT NOISE ON CLOSING

7.38 Cross Talk — Cross talk shall be measured using an equipment which shall have an input impedance of 1 megohm (minimum) and shall be paralleled with a capacitance of 20 pF maximum. A 1.0 to 10.0 volts peak-to-peak input signal at frequencies up to 10 MHz shall be applied to the switching circuit through coaxial cable terminated in 50 ohms \pm 5 percent at the device terminal. The coaxial cable shall conform to IS : 5801-1970*. The input signal amplitude shall be measured at the input connection of the switch. The cross talk signal shall be connected through a similar type coaxial cable; terminated in 50 ohms \pm 5 percent at the measuring device. The resultant attenuation in decible equals:

$$20 \log_{10} \left(\frac{E_{in}}{E_{out}} \right)$$

where

E_{in} = input voltage, and

E_{out} = output voltage

7.39 Contact Sticking — Relays shall be energised for 96 hours with 120 percent of rated voltage applied to the coil. No load shall be applied to the contacts. At the end of this period without physically disturbing the relays, the coil shall be de-energised and the following measurement made:

Operate and release time — See 7.11.

APPENDIX A

(Clause 7.30)

LIFE TEST

A-1. OBJECT

A-1.1 The object of this test is to determine the effects on the relays due to exposure for a specified duration of time and/or for a specified number of mechanical operations at elevated temperatures combined with or without specified electrical stress.

A-2. TEST CHAMBER

A-2.1 The test chamber shall be capable of maintaining its working space at a temperature of $70 \pm 3^{\circ}\text{C}$ or any other selected temperature in the

*Specification for flexible coaxial radio frequency cables with characteristic impedance 50 Ω .

range of severities of the dry heat test within a tolerance of $\pm 3^{\circ}\text{C}$. In all other respects the chamber shall conform to IS : 9002 (Part II)-1977*.

A-2.2 While the relays are maintained at the required temperature, it shall be possible to apply the required electrical stress and/or mechanical operations in the manner specified by the relevant specification.

A-3. TEST PROCEDURE

A-3.1 Mounting of Relays — Relays shall be mounted as specified by their normal mounting means. When groups of relays are to be subjected to test simultaneously, the mounting distance between relays shall be as specified for the individual groups. When the distance is not specified, the mounting distance shall be sufficient to minimize the temperature of one component affecting the temperature of another. Relays fabricated of different materials, which may have detrimental effect on each other and after the results of this test, shall not be tested simultaneously.

A-3.2 Testing — The relays mounted as specified in **A-3.1** shall be placed in the chamber conforming to the requirements of **A-2** and shall be subjected to electrical and/or mechanical stresses as specified by the relevant specification. The temperature of the chamber shall be adjusted to the specified value and shall be maintained at this value throughout the test.

A-3.2.1 Unless otherwise specified by the relevant specification the duration of this test shall be one of the values specified in Table 5.

TABLE 5 TIME DURATION FOR LIFE TEST

TIME (HOURS)

100
250
500
1 000
2 000
3 000
5 000
10 000
30 000
50 000

*Equipment for environmental tests for electronic and electrical items: Part II Chamber for dry heat test.

A-3.2.2 If the number of mechanical operations are to be specified instead of time duration, unless otherwise specified by the relevant specification the number of operations for this test shall be one of the values specified in Table 6.

TABLE 6 NUMBER OF OPERATIONS FOR LIFE TEST

NUMBER OF OPERATIONS

100
200
500
1 000
2 000
3 000
5 000
10 000
15 000
25 000
50 000
100 000
200 000
300 000
500 000
1 000 000
2 000 000
3 000 000
5 000 000
10 000 000

A-3.2.3 Throughout the duration of this test, the required electrical and/or mechanical stresses shall be applied to the relays in the manner specified by the relevant specification, which, if required, shall also specify monitoring or measuring of selected electrical characteristics during this period.

A-3.3 Recovery — The relays shall be removed from the chamber. The relays shall then be allowed to remain under recovery conditions for two hours or such longer period as is required to attain temperature stability.

A-4. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

- a) Preconditioning, if any;
- b) Initial measurements;
- c) The temperature at which the test shall be carried out;

- d) Whether the test is to be repeated in part or whole at any other temperature;
- e) The period, manner and rate of application of the electrical and/ mechanical stresses;
- f) Duration of the test;
- g) The maximum permissible surface temperature of the relays, if applicable;
- h) Intermediate measurements and time intervals;
- j) Final measurements;
- k) Acceptable performance limits; and
- m) Any deviation from the normal test procedure.

INDIAN STANDARDS

ON

ELECTROMECHANICAL COMPONENTS FOR ELECTRONIC EQUIPMENT

IS :

- 1885 (Part XXVI)-1968 Electrotechnical vocabulary : Part XXVI Telecommunication relays
- 2628 Rotary wafer switches (low current rating) :
(Part I)-1964 Tests and general requirements
(Part II)-1967 Rotary wafer switches with central mounting
- 3354 Valve sockets :
(Part I)-1965 General requirements and tests
(Part II)-1965 Dimensions and construction of gauges and tools
(Part III)-1967 Valve sockets for octal base
(Part IV)-1967 Valve sockets for 9-pin miniature base
- 3452 Toggle switches :
(Part I)-1966 General requirements and tests
(Part II)-1970 Toggle switches, Type I and Type II
- 3544-1966 General requirements and test for tag strips
- 4007 (Part I)-1982 Terminals for electronic equipment : Part I General requirements and tests (*first revision*)
- 4586 (Part I)-Dimensions of spindles and mounting arrangements for spindle operated electronic components : Part I Spindles
(Part I/Sec 1)-1978 Section 1 General and definitions
(Part I/Sec 2)-1978 Section 2 Plain round spindles
(Part I/Sec 3)-1978 Section 3 Flatted spindle
(Part I/Sec 4)-1978 Section 4 Slotted spindle
(Part I Sec 5)-1978 Section 5 Hollow spindle
(Part I/Sec 6)-1978 Section 6 Coupling spindle
(Part I/Sec 7)-1978 Section 7 Concentric spindle
(Part I/Sec 8)-1978 Section 8 Double flatted spindle
(Part I/Sec 9)-1978 Section 9 Knurled spindle
(Part I/Sec 10)-1978 Section 10 Slotted and knurled spindle
- 4586 (Part II) Dimensions of spindles and mounting arrangements for spindle operated electronic components : Part II Mounting arrangements
(Part II/Sec 1)-1980 Section 1 Components and panel cutouts
(Part II/Sec 2)-1980 Section 2 Fixing nuts
- 4794 (Part I)-1968 Push-button switches : Part I General requirements and tests
- 4795 Holders for indicator lamps for electronic and telecommunication equipment :
(Part I)-1968 General requirements and tests
(Part II)-1978 Type E10, E14 and BA9
- 5033-1969 Telescopic aerials for portable radio receivers

IS:

- 5051 (Part I)-1982 Relays for electronics and telecommunication equipment: Part I
General requirements and tests (*first revision*)
- 6089 (Part I)-1971 Sensitive switches : Part I General requirements and tests
- 6102 (Part I)-1971 Finger knobs used in electronic and telecommunication equip-
ment : Part I General requirements and tests
- 7542 (Part I)-1974 Tube shields : Part I General requirements and tests
- 7751 (Part I)-1975 Slide switches : Part I General requirements and tests
- 9606-1980 Dimensions of panels and racks (482·6 mm system)

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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